AMENDMENT TO THE CLAIMS

1–62. (Cancelled)

63. (Withdrawn) A method for manufacturing a solid-state imaging device in which an imaging region in which a plurality of unit pixels are arranged is provided on a semiconductor substrate, each of the unit pixel including a plurality of element formation regions and an element isolation formation region located between the plurality of element formation regions, the method comprising:

a step (a) of forming, on the semiconductor substrate, a protection film including an opening portion that exposes the element isolation formation region of the semiconductor substrate;

a step (b) of forming a trench by removing a part of the element isolation formation region of the semiconductor substrate by etching using the protection film as a mask;

a step (c) of removing the protection film after the step (b); and

a step (d) of performing thermal treatment in an atmosphere including hydrogen at a temperature in a range between 1000°C and 1300°C, both inclusive, after the step (b).

64. (Withdrawn) The method for manufacturing a solid-state imaging device of Claim 63,

wherein in the step (d), a semiconductor film of a semiconductor material composing the semiconductor substrate is formed so as to cover an upper part of the trench by the thermal treatment, and

the method further comprising: a step (e) of implanting an impurity having a conductivity type different from that of the element formation regions into the semiconductor film after the step (d).

65. (Withdrawn) The method for manufacturing a solid-state imaging device of Claim 63,

wherein in the step (d), a semiconductor film of a semiconductor material composing the semiconductor substrate is formed so as to cover an upper part of the trench by the thermal treatment, and

the method further comprising: a step (f) of oxidizing the semiconductor film after the step (d).

66. (Withdrawn) The method for manufacturing a solid-state imaging device of Claim 63, further comprising:

a step (g) of subjecting a side face portion of the trench in the semiconductor substrate to thermal oxidation after the step (b) and before the step (d).

67. (Withdrawn) The method for manufacturing a solid-state imaging device of Claim 63, further comprising:

a step (h) of forming an insulating film on a side face of the trench after the step (b) and before the step (d).

68. (Withdrawn) The method for manufacturing a solid-state imaging device of Claim 63,

wherein a peripheral circuit region including a drive circuit for operating the imaging region is provided beside the imaging region in the semiconductor substrate, and

an element isolation region of the peripheral circuit region is formed by the same step as a step of forming an element isolation region of the imaging region.

69. (Withdrawn) The method for manufacturing a solid-state imaging device of Claim 68,

wherein in the peripheral circuit region, only a NMOS transistor, only a PMOS transistor, or a CMOS transistor is formed.

70 (Currently amended) A method for manufacturing a solid-state imaging device in which an imaging region in which a plurality of unit pixels are arranged is provided on a semiconductor substrate, each of the unit pixel including a plurality of element formation regions and an element isolation formation region located between the plurality of element formation regions, the method comprising:

a step (a) of forming, on the semiconductor substrate, a protection film including an opening portion that exposes the element isolation formation region and a region located beside the element isolation formation region <u>of an upper face</u> of the semiconductor substrate;

a step (b) of forming a sidewall on a side face of the opening in the protection film;

a step (c) of forming a trench in the element isolation formation region in the semiconductor substrate by etching using the protection film and the sidewall as a mask;

a step (d) of oxidizing a side face portion of the trench in the semiconductor substrate by using the protection film and the sidewall as a mask after the step (c) to form an inner wall thermal oxide film;

a step (e) of forming an element isolation region by burying the trench with a burying film after the step (d); and

a step (f) of forming a photoelectric conversion section and an active region in the element formation regions after the step (e),

wherein in the step (c) the width of the trench is made smaller by the thickness of the sidewall than the width of the opening in the protection film,

in the step (f), ~~due to the width of the trench narrower than the width of the opening in the protection film,~~ the photoelectric conversion section and the active region are arranged apart from the element isolation region by the thickness of the sidewall, and

in the step (d), the inner wall thermal oxide film, due to the sidewall formed on the side face of the opening in the protection film, is formed to an edge of the semiconductor substrate which is located at an upper edge portion of the trench.

71. (Cancelled)

72. (Withdrawn) The method for manufacturing a solid-state imaging device of Claim 63,

wherein in the step (a), a width of the opening portion is narrower than a width of the element isolation formation region.

73. (Withdrawn) A method for manufacturing a solid-state imaging device in which an imaging region in which a plurality of unit pixels are arranged is provided on a semiconductor substrate, each of the unit pixel including a plurality of element formation regions and an element isolation formation region located between the plurality of element formation regions, the method comprising:

a step (a) of forming, on the semiconductor substrate, a protection film including an opening portion that exposes a part of the element isolation formation region of the semiconductor substrate;

a step (b) of forming a trench having a depth two time larger than a width thereof by removing a part of the element isolation formation region of the semiconductor substrate by etching using the protection film as a mask; and

a step (c) of forming a TEOS film for burying the trench by CVD after the step (b).

74. (Withdrawn) A method for manufacturing a solid-state imaging device provided with, on a semiconductor substrate, an imaging region in which a plurality of unit pixels respectively including photoelectric conversion sections and active regions are arranged,

wherein in a step of forming an element isolation trench between the photoelectric conversion sections and between the respective photoelectric conversion regions and the respective active regions in the semiconductor substrate, a wall of the element isolation trench is tapered.

75. (Withdrawn) The method for manufacturing a solid-state imaging device of Claim 74, comprising the step of, after a first insulating film and a second insulting film different

in kind from the first insulating film are deposited on the semiconductor substrate sequentially, pattering the first insulating film and the second insulating film before the step of forming the element isolation trench,

wherein the step of forming the element isolation trench includes a step of etching the semiconductor substrate using the patterned first insulting film and the patterned second insulating film as a mask.

76. (Withdrawn) The method for manufacturing a solid-state imaging device of Claim 75,

wherein in the step of etching the semiconductor substrate, a flow rate of an oxygen gas is set to be 5 % or lower of a flow rate of a chlorine gas.

77. (Currently amended) A solid-state imaging device in which an imaging region in which a plurality of unit pixels are arranged is provided on a semiconductor substrate, each of the unit pixels including a plurality of element formation regions and an element isolation formation region located between the plurality of element formation regions,

wherein in the element isolation formation region, a trench is formed in a part of the semiconductor substrate, an inner wall thermal oxide film is formed by oxidizing a side face portion of the trench and a burying film is provided for burying the trench,

a photoelectric conversion section and an active region are formed in the element formation regions,

the trench is formed by removing a part of the semiconductor substrate using a protection film which covers the element formation regions <u>of an upper face</u> of the semiconductor substrate

and which includes an opening portion that exposes the element isolation formation region and a region located beside the element isolation formation region of the semiconductor substrate and a sidewall provided on a side face of the opening portion in the protection film as a mask,

an element isolation region is formed in the element isolation formation region,

the width of the trench is made smaller by the thickness of the sidewall than the width of the opening in the protection film, and

~~due to the width of the trench narrower than the width of the opening in the protection film,~~ the photoelectric conversion section and the active region are arranged apart from the element isolation region by the thickness of the sidewall, and

the inner wall thermal oxide film, due to the sidewall formed on the side face of the opening in the protection film, is formed to an edge of the semiconductor substrate which is located at an upper edge portion of the trench.

78. (Withdrawn) A solid-state imaging device in which an imaging region in which a plurality of unit pixels are arranged is provided on a semiconductor substrate, each of the unit pixels including a plurality of element formation regions and an element isolation region located between the plurality of element formation regions,

wherein in the element isolation region, a trench located in an upper part of the semiconductor substrate is formed, an element isolation film electrically isolating between the plurality of element formation regions is provided so as to cover at least an upper part of the trench, and a cavity is formed at a part within the trench.

79. (Withdrawn) A solid-state imaging device comprising:

a semiconductor substrate; and

an imaging region provided on the semiconductor substrate in which a plurality of unit pixels respectively including photoelectric conversion sections and active regions are arranged,

wherein an element isolation trench is formed between the photoelectric conversion sections and between the respective photoelectric conversion sections and the respective active regions, the element isolation trench having a tapered wall.

80. (Withdrawn) A solid-state imaging device comprising:

a semiconductor substrate; and

an imaging region provided on the semiconductor substrate in which a plurality of unit pixels respectively including photoelectric conversion sections and active regions are arranged,

wherein an element isolation trench is formed between the photoelectric conversion sections and between the respective photoelectric conversion sections and the respective active regions, a wall face of the element isolation trench forming an angle within a range between 110° and 130°, both inclusive, with respect to a surface of the semiconductor substrate.

81. (Previously presented) The method for manufacturing a solid-state imaging device of Claim 70,

wherein the photoelectric conversion section and the active region include a n-type impurity, and

the method further comprising the step of implanting a p-type ion into a side face portion of the trench in the semiconductor substrate by using the protection film and the sidewall as a mask after the step (c) and before the step (d).

82. (Withdrawn) The method for manufacturing a solid-state imaging device of Claim 63,

wherein a part of the element formation regions of the semiconductor substrate includes a n-type impurity,

the method further comprising:

a step (i) of implanting a p-type ion into a surface portion of the trench in the semiconductor substrate after the step (b) and before the step (d).

83. (Previously presented) A camera characterized by using the solid-state imaging device of Claim 77.

84. (Withdrawn) A camera characterized by using the solid-state imaging device of Claim 78.

85. (Withdrawn) A camera characterized by using the solid-state imaging device of Claim 79.

86. (Withdrawn) A camera characterized by using the solid-state imaging device of Claim 80.

87. (New) The method for manufacturing a solid-state imaging device of Claim 70, further comprising:

a step (g) of performing wet etching to remove the protection film under the condition that the etch rate of the protection film is higher than that of the burying film after the step (e) and before the step (f), wherein

in the step (g), the sidewall is removed deeper than the burying film, and whereby the burying film is located higher in level than the remaining sidewall.

88. (New) The solid-state imaging device of Claim 77, wherein

wet etching is performed and the protection film is removed under the condition that the etch rate of the protection film is higher than that of the burying, whereby the sidewall is removed deeper than the burying film and the burying film is located higher in level than the remaining sidewall.

89. (New) The method for manufacturing a solid-state imaging device of Claim 70, wherein the opening portion exposes the element isolation without removing the upper part of the semiconductor substrate.

90. (New) The method for manufacturing a solid-state imaging device of Claim 70, wherein the sidewall is not formed on the side face of the semiconductor substrate.

91. (New) The solid-state imaging device of Claim 77, wherein the opening portion exposes the element isolation without removing the upper part of the semiconductor substrate.

92. (New) The solid-state imaging device of Claim 77, wherein the sidewall is not formed on the side face of the semiconductor substrate.